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This document reviews the work of the Office of Research and Development's media-specific research committees for the fiscal year (FY)1984. The chapters of the document are organized around each of the five committees--Air and Radiation, Water, Toxics and Pesticides, Hazardous Waste/Superfund, and Multimedia Energy. Each chapter summarizes the major research issues identified by the committee in question, highlights FY 1984 accomplishments that respond to those issues, and identifies related research to be performed in FY 1985.

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FOREWORD

With the establishment of five media-specific research committees in 1983, EPA's Office of Research and Development (ORD) has endeavored to improve the process through which the Agency plans and budgets its research program. Because the overall goal of EPA's research program is to provide the scientific and technical information necessary to support the Agency's regulatory and enforcement responsibilities, representatives of ORD's client program offices serve as co-chairs, with senior ORD managers, on each of our five research committees (Air and Radiation; Water; Toxics and Pesticides; Hazardous Wastes and Superfund; and Multimedia-Energy). The membership of each committee broadly represents the Agency's program office and regional interests. We strongly believe that the EPA research committee system has strengthened our ability to plan and manage the essential scientific and technical work of the Agency.

Marking the completion of the first full year of operation of the consolidated research committee process, each committee prepared an annual report for FY-1984. These reports: (1) summarize major research issues as identified by each committee; (2) highlight FY-1984 accomplishments that respond to those issues; and (3) identify related research to be performed in FY-1985. The major purpose of this document is to acquaint the reader with the interests of each committee, and to highlight specific research outputs. We hope that you find the reports enlightening and useful.

Donald J. Ehreth
Deputy Assistant Administrator
for Research and Development

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AIR AND RADIATION RESEARCH COMMITTEE

FY 1984 ANNUAL REPORT

INTRODUCTION:

The Air research program provides OAR with the scientific data bases, methodologies, assessments, models, emission reduction technologies and corresponding quality assurance support to develop and implement air quality standards and ensure compliance with them. The research program focuses on the six "criteria" air pollutants (ozone, carbon monoxide, particulate matter, sulfur dioxide, nitrogen oxide and lead), and on potentially hazardous air pollutants which are defined as pollutants which cause irreversible or reversible incapacitating illness and have not already been regulated as criteria pollutants.

In an effort to develop a more cohesive, responsive, long-range research program, the Assistant Administrators for Research and Development and Air and Radiation identified the priority research issues for the Air and Radiation research programs. These issues cut across scientific disciplines (e.g., monitoring, health, engineering, environmental processes), and the pollutant-specific structure of the research programs. The following discussion of ORD's major accomplishments in FY 1984 are organized by these issues. A more detailed list of the research projects delivered to the Office of Air and Radiation in FY 1984 is attached.

ISSUE: WHAT RISK ASSESSMENT DOCUMENTS ARE NEEDED AND WHEN TO SUPPORT NAAQS & NESHAPs?

The Office of Health and Environmental Assessment completed the second external review draft of the criteria document for lead and the first external review draft of the criteria document for ozone and other photochemical oxidants. The addendum to the 1979 criteria document for carbon monoxide (CO) was also published in 1984. Final health assessment documents were completed for acrylonitrile, carbon tetrachloride, coke oven emissions, chromium, inorganic arsenic, manganese, mercury, toluene and methyl chloroform. External review drafts were completed for an additional thirteen chemicals.

ISSUE: WHAT DOSE-RESPONSE INFORMATION IS NEEDED TO REDUCE THE UNCERTAINTIES ASSOCIATED WITH THE ADVERSE HEALTH EFFECTS OF AIR POLLUTANTS TO SUPPORT NAAQS AND NESHAPs?

Three articles were published in refereed journals on research responding to critical data gaps in the dose-response data base for sulfur dioxide (SO_2) and ozone (O_3). One article described the pulmonary responses of exercising asthmatics exposed to SO_2 in controlled laboratory conditions. The other two articles discussed in-vitro and in vivo animal tests which were conducted

to measure changes in immune function, metabolism and other biological parameters following acute exposures to SO_2 and O_3.

The early phases of studies assessing the effects of low level CO on patients with angina were completed to support the review of the CO NAAQS. Reports have been written and prepared for publication.

Studies designed to determine whether diesel emissions are carcinogenic, and if they are, how potent they are, have been completed to support the program office in regulating mobile source emissions. A report on the use of tier bioassays in evaluating unregulated motor vehicle emissions was completed.

Several in-vivo and in vitro studies identifying the metabolites and routes of metabolism and activation of 1-nitropyrene were completed. This chemical, which has been identified as a mutagen and carcinogen, is a common combustion product. The results of these studies will be used for developing strategies to control combustion product emissions.

Neurotoxicity studies of toluene were completed. Based upon the results of these studies and other data already gathered on toluene, OAR decided not to list toluene as a hazardous air pollutant. An article on the reproductive effects of exposure to manganese on the male rat was prepared to support listing decisions.

A report, The Biological Effects of Radiofrequency Radiation was published to provide the scientific basis for the program office to develop radiation protection guidance.

ISSUE: WHAT MODELS ARE NEEDED TO EXTRAPOLATE FROM ANIMAL TO HUMAN RISKS, FROM HIGH TO LOW DOSES AND FROM ACUTE TO CHRONIC EFFECTS?

In 1984, ORD initiated a multi-phase program to develop quantitative models to extrapolate from acute human studies and acute and chronic animal studies to long-term human health effects of air pollutants. A report describing the sensitivity of several animal species, including humans, to O3 inhalation was produced.

ISSUE: WHAT RESEARCH IS NEEDED TO DETERMINE THE CONTRIBUTION OF AIR POLLUTION TO THE INCIDENCE OF CANCER IN THE UNITED STATES?

Plans for a long-term, interdisciplinary integrated air cancer project were developed during 1984. The purpose of the project is to provide an improved capability for performing cancer risk assessments on airborne pollutants. The goals of the program are to identify the principal airborne carcinogens, determine which emission sources are major contributions of carcinogens to the ambient air and improve the estimate of comparative human cancer risk from specific air pollution emission sources.

ISSUE: WHAT INFORMATION IS NEEDED ON THE WELFARE EFFECTS OF POLLUTANTS TO SUPPORT SECONDARY STANDARDS?

Based upon data gathered through the National Crop Loss Assessment Network (NCLAN), an economic assessment on the effects of O_3 on agriculture was produced. Reports of the economic methodology used to assess O_3 damage were also produced in 1984.

A comprehensive multi-year research plan was developed in 1984 to assess the problem of visibility degradation. In addition to developing this plan, a number of studies on the optical properties of ambient air aerosols and plume visibility were completed.

ISSUE: WHAT INFORMATION IS NEEDED ON THE ATMOSPHERIC CHEMISTRY AND PHYSICS OF AIR POLLUTANTS TO DEVELOP AND IMPROVE AMBIENT AIR QUALITY MODELS IN SUPPORT OF SIPs?

To improve urban scale ambient air quality models, a protocol for developing a reactivity classification system for VOCs was prepared. This protocol will enable us to determine the extent that specific VOCs contribute to the formation of O_3. This information is needed to determine whether certain VOCs emission need to be controlled to achieve O_3 standards.

Field and laboratory studies were conducted to determine the life times, spatial and temporal distributions and transformation products of selected hazardous air pollutants. The roles of wet and dry deposition in removing such pollutants from the atmosphere were determined.

An improved second generation regional O_3 model was completed. This model will be used to predict the air quality impact of long-range O_3 transport to urban areas located downwind. Analysis of the results of the Cross Appalachian Tracer Experiment was completed. This was a multi-agency effort to quantify long-range gas and particulate matter transport processes.

An assessment document was prepared for OAR on the status of complex terrain dispersion models. These models enable the program office to better predict the impact of sources on ambient air quality in areas with complex terrain. Also, fluid modeling studies were completed for a variety of complex terrain effects.

Several user's guides were developed to assist regional, state and local air pollution officials in applying specific air quality models. In 1984, user's guides were completed for the Pollution Episodic Model, a Single Source Gaussian Puff Dispersion Model (INPUFF), a Photochemical Box Model, and Mesopuff-II.

ISSUE: WHAT MOBILE SOURCE EMISSION CHARACTERIZATIONS ARE NEEDED TO EVALUATE THE EFFECTIVENESS OF CONTROL STRATEGIES?

Research characterizing gaseous and particulate mobile source emissions from heavy-duty diesel and gasoline-powered trucks and buses was completed.

Human exposure data collected during the winter of 1982-83 as part of the Denver and Washington, D.C., CO studies was analyzed. Statistical analyses of the exposure and activity patterns in these cities were conducted and papers prepared summarizing these data. As part of the indoor air research program, an air quality research strategy was developed.

ISSUE: WHAT STATIONARY SOURCE EMISSION CHARACTERIZATIONS AND TECHNOLOGY EVALUATIONS ARE NEEDED TO SUPPORT SIPs AND NSPS?

Research to control particles focused on improving the performance, reliability and cost-effectiveness of electrostatic precipitators (ESPs) and fabric filters in collecting small particles which have become increasingly important in meeting particle standards. The technical limits of applying large diameter electrodes in new or existing ESPs were determined. These studies indicated that particulate emissions can be reduced by as much as a factor of four in some retrofit applications. ESPs, which combine the features of large diameter electrodes and two stage ESPs into one multi-stage unit, will be especially economical for power plants using low sulfur coal. A two dimension computer model was developed to assess the electrical nature of ESP designs. ESP vendors hope to utilize this model to improve their ESP designs, while the Agency will use the model as a diagnostic aid for compliance and permitting activities. Preliminary research on a multi-stage ESP designed to control both SO_2 and particulates ($E\text{-}SO_x$) produced results of 40-90 percent SO_2 removal while still meeting particulate standards.

The performance of fabric filtration continues to be improved with the application of electrostatically enhanced fabric filtration (ESFF). In 1984, a test of commercial-sized fabric filter bags was conducted at a pilot baghouse. This test demonstrated that ESFF is operable at one-half the pressure drop (energy loss) of the conventional bags in service. Additional research indicates that one-fourth the pressure drop expected in a spray dryer/baghouse combination can be achieved with ESFF. The application of this technology could reduce capital costs by 50% and result in lower maintenance costs for baghouse filters which are extensively used for cleaning gases.

Wind tunnel experiments were conducted and were used to develop a mathematical model to determine the optimal windbreak porosity, size and location of fugitive emissions. This model will be used to control fugitive emissions from storage piles.

In conjunction with The Electric Power Research Institute (EPRI), the Fifth Symposium for the Transfer and Utilization of Particulate Control Technology was conducted to extend particulate control technology to designers, users and educators.

Research to control SO_2 emissions resulted in a full-scale field evaluation of a lime spray dryer method. Short-term test results showed that the NSPS for SO_2 and particulate matter can be met at costs lower than when conventional wet scrubbing systems are used. A full-scale evaluation of a flue gas desulfurization (FGD) method was conducted using a dibasic

acid to enhance the performance of limestone scrubbing FGD systems. The results of this test indicated that compliance SO_2 removal could be obtained consistently with reduced operational and maintenance problems at an estimated annual cost savings of $600,000 per year.

The Ninth FGD Technology Symposium was conducted in conjunction with the EPRI to provide the utility industry, vendors and regulatory officials with up-to-date guidance on technologies for SO_2 control and acid deposition mitigation options.

Research to control NO_x emissions focused on low NO_x burners, in-furnace NOx reduction, air staging/recirculation and catalytic reduction. In 1984, a low NO_x burner was successfully evaluated on an oil field steamer with 75% reduction of NO_x emissions. Also, two demonstrations utilizing second generation (recirculation) low NO_x burners were successfully completed. One demonstration was on a 400MW tangentially-fired utility boiler, and the other was on a 200MW wall-fired, industrial size utility boiler. In both cases NO_x emissions of 0.4 $lbs/10_6$ btu were achieved. These successful demonstrations allowed OAR to use this technology in the development of a NSPS for cement kilns during 1984.

Pilot- and commercial-scale destruction efficiency tests of VOCs were conducted using industrial flares. The results of the VOC flare tests were used by OAR to revise a number of industry specific NSPS. The results were also instrumental in achieving a settlement with the Chemical Manufacturers of America in their petition on industrial flare performance.

Research to control hazardous air pollutants focused on identifying the major sources and evaluating applicable control technologies. In 1984, source assessments for copper and butadiene emissions were made. Also, a comprehensive literature review of control technologies for hazardous air pollutants was conducted, and a method for ranking industrial sources of hazardous air pollutants by process parameters was developed for OAR.

WATER RESEARCH COMMITTEE

FY 1984 ANNUAL REPORT

This report highlights the major Office of Research and Development (ORD) accomplishments in water research for FY-1984. A summary of activities is presented on the major research issues which the Office of Water (OW) and the ORD jointly identified. Appendices contain information on technical publications and resources (dollars and people) as well as a summary of the issues.

The Committee identified groundwater, marine/estuarine systems, the water quality based approach to toxics, and sludge as the research areas for 1984 emphasis.

The Committee issued guidelines for joint ORD-OW operating procedures established technical Research Planning Groups (Water Quality, Wastewater, Marine, Groundwater, and Drinking Water) that focus on identifying priority research projects. Planning groups include ORD, OW and Regional technical personnel. A systematic review of the current year (FY 85) research and program operating plans was completed by these groups. This ensured coordination with the Program Office and Regions, not only on research plans, but also on current activities. The final 1985 ORD plans and proposed 1986 budget were reviewed by these teams. A consensus was reached on all major issues and problems.

Major projects in several fields have been essentially completed by ORD. These include completion of the Chesapeake Bay research program; work in support of effluent guidelines; research on land application of sludge and wastewater.

The FY 1984 research accomplishments and major outputs are summarized in the following pages. Appendix III contains the 1984 water research publications. Many such products have completed peer review and are available for Agency use in draft form pending final publication.

Water Quality Based Approach

ORD and OW affirmed their strategic commitment to biomonitoring as a key tool in EPA's regulatory approach for toxics control. The development of field oriented short-term chronic toxicity tests by ORD's Duluth laboratory is providing the Agency and States with effective, low-cost methods to limit the adverse effects of toxic pollutants in water. Through a series of workshops on these short-term chronic toxicity tests and on incorporating toxicity limits into permits, jointly sponsored with OW, the transfer of the overall concept has been most effective. The methods and approach have been endorsed by many states and foreign countries. OW and ORD have jointly conducted field verification studies in Ohio, Connecticut, Alabama, Oklahoma and West Virginia that have greatly aided the acceptance of the complex-effluent-toxicity approach.

National site-specific criteria guidelines were updated and single-chemical aquatic-life Criteria Documents were developed for nine compounds. An article was published on the relationships among observed metal concentrations, water quality criteria and biological integrity in 15 streams across the United States.

Another approach developed by ORD at ERL-Corvallis is the ecoregion concept for site-specific stream evaluations of water quality and biological life. This method classifies streams according to similar physical characteristics such as soil, natural vegetation, and topography. Maps have been constructed for several areas (Oregon, Washington, Idaho, Arkansas, Ohio) and a national ecoregions map will be completed in FY 1985. This approach is being field-verified in Regions 5, 6, and 10.

In addition to providing research on aquatic effects and methods, ORD supported OW in addressing human health effects related to water quality. The main accomplishment in 1984 was the completion of the Freshwater Recreational Water Quality Criteria Document. These criteria represent a substantial improvement in the Agency's ability to relate the level of bacterial contamination of water to human health effects. ORD also drafted the human health effects section of the Technical Support Document for Water Quality Based Toxics Control; participated in the revision of several water quality criteria for aquatic life for both fresh and marine waters.

Ocean Disposal

ORD consolidated most of its marine research activities under its Environmental Research Laboratory (ERL) at Narragansett, Rhode Island, reducing overhead costs and consolidating technical resources. Researchers participated in EPA's decision-making under the 301(h) waiver program for ocean outfalls. The "Bays Program" - a comprehensive national effort to solve high priority problems on selected major estuaries such as Puget Sound - was planned by a Regional/OW/ORD joint venture.

Research on the procedures to characterize sludge prior to ocean dumping was completed in 1984. ERL-Narragansett, working through an Interagency Agreement with the Corps of Engineers, produced two major reports on the character and bioaccumulation of contaminants from dredged materials that are dumped into the ocean. This lab also developed a research strategy for disposal of radioactive soil through a joint research program with the University of Rhode Island's Marine Ecosystem Research Laboratory.

The ERL-Gulf Breeze continues to work extensively with OW and the Regional Offices in developing Best Available Technology (BAT) guidelines for regulating discharges from offshore oil and gas platforms. A major 1984 output of this effort is a report entitled "Results of the Drilling Fluid Research Sponsored by Gulf Breeze (1976-1983) and Their Application to Hazard Assessment."

Cooperative assistance across ORD occurred when scientists from several ORD laboratories (ERL's Narragansett, Gulf Breeze, Cincinnati and RTP)

participated in the development of a Research Strategy for Incineration-at-Sea in response to a request from the Office of Water.

Groundwater

EPA's Ground-Water Protection Strategy recognizes that EPA and the States have a number of mandates for protecting ground water. Almost every regulatory and enforcement program in EPA has some interest in ground-water protection: hazardous wastes; superfund; toxics; pesticides; radiation; and drinking water. In response to these needs, ORD conducts research to provide a broad range of data and information for use by decision-makers concerned with ground-water protection.

In 1984, a number of important reports were published: (1) Methods for Determining the Mechanical Integrity of Class II Injection Wells; (2) Methods for Determining the Location of Abandoned Wells, (3) Evaluation of Septic Tank System Effects on Ground-Water Quality; (4) Handbook of Mathematical Models for Ground-Water Transport; and (5) A guide to the Selection of Materials for Monitoring Well Construction and Ground-Water Sampling. A number of technology transfer activities included conferences on Location of Abandoned Wells, Ground-Water Quality Research, Aquifer Restoration and Ground-Water Monitoring, and Surface and Borehole Geophysics in Ground-Water Investigations. Four training courses were also provided to EPA regional personnel on Modeling Subsurface Flow and Contaminant Transport.

Two other significant efforts in information transfer are the National Ground-Water Information Center, through which access can be gained to the world's ground-water technical literature, and the International Ground-Water Modeling Center, which provides information on available ground-water models for specific needs.

Drinking Water Health Effects

Long-term studies were undertaken on the carcinogenic effects of corn oil when used as the dosing vehicle for chlorinated hydrocarbons in mice. The results raise questions about the validity of the results of studies using corn oil as a carrier for chlorinated hydrocarbons in conducting health risk assessments, since the water-vehicle control group did not develop tumors. Further studies are planned to clarify the utility of data collected from similar studies in human risk assessment.

A conference on cardiovascular disease and inorganic compounds in drinking water was held to summarize the data available in this area. The conclusions were: (1) there does not appear to be a relationship between sodium in drinking water and cardiovascular disease and (2) there appears to be a relationship between soft water, calcium deficient diet, drinking water disinfectants, and cardiovascular disease. Studies indicate that both chlorine and chlorine dioxide exposure could increase serum cholesterol levels and atherosclerotic plaque formation when given to animals receiving a calcium deficient diet and drinking water low in calcium. The exact

mechanism of action is not known but could be related to the antithyroid effect of disinfectants. Research will continue to investigate this problem.

HERL-Cincinnati provided considerable technical assistance to EPA Region 3 and the State of Pennsylvania in investigating waterborne giardiosis outbreaks involving several communities and 350,000 people. An immune-fluorescent-antibody technique, developed in the laboratory, was used to identify the presence of Giardia cysts in the water supplies verifying the cause of the the outbreak. In addition, the scientists participated in a training course to teach water suppliers how to use this technique.

A major advance was made in EPA's capabilities to measure viruses in drinking water. A method was developed to concentrate, grow and quantify hepatitis virus in culture from drinking water. The refinement of this method will enable EPA to investigate the occurrence and effects of this agent.

A peer review panel recommended four areas where EPA should use epidemiology as a tool for determining the health effects of drinking water contaminants: 1) the relationship between drinking water disinfectants and cancer; 2) the relationship between naturally occurring compounds (i.e., radon) and health effects; 3) the relationship between cardiovasuclar disease and drinking water quality; and 4) the relationship between drinking water contaminants and reproductive effects. Their report will be used to direct epidemiology research to areas with significant impact on developing drinking water standards.

Thirty-one criteria documents, ranging from pesticides to heavy metals, were prepared by the Environmental Criteria and Assessment Office for the Office of Drinking Water (ODW). These documents are used by ODW in developing Health Advisories and adjusted Acceptable Daily Intake (ADI) levels to estimate safe levels of contaminants in the Nation's drinking water. Drafts of the criteria documents were reviewed by both ODW and ORD scientists; the next step involves solicitation of public comments and finalization of the documents.

Drinking Water Technology

A serious problem of interference to coliform detection in some drinking water supplies can now be resolved as a result of a recent protocol modification funded by EPA at the University of Arizona. This simple technique involves anaerobic rather than aerobic incubation of the standard membrane filters used for coliform tests. In another important development, amphipods passing through water treatment have been demonstrated to provide a mechanism for coliform survival and passage into the distribution system in the presence of chlorine residuals.

Activities in engineering research continued to emphasize treatment technology in support of drinking water regulation revisions and compliance. Several project reports on adsorption of organic contaminants were integrated into one summary statement on the operation and cost of granular-activated-

carbon treatment of drinking water. The cost of treating water by small utilities varied significantly with different processes. In anticipation of a possible regulation to filter all public surface supplies, a report on filtration to control Giardia cysts was issued; a similar report was prepared on aeration technology for reducing volatile organics in ground water. Reports were also issued on treatments to control excess fluorides and lead.

Great Lakes

The Great Lakes research program continued to provide support to the U.S./Canada Water Quality Agreement, the International Joint Commission (IJC), and the Regions in developing methodologies for measurement, description, predictions of sources and effects of toxic substances in the Great Lakes. Major activities included: a surveillance plan for Lake Huron completed for the IJC Surveillance Work Group; a Great Lakes-wide evaluation of sodium loadings and projected concentrations near completion for the Great Lakes National Program Office (GLNPO); analyses for PCBs for Region V's Westinghouse case; and the point-source file for Great Lakes Basin is near completion for the IJC and GLNPO.

A general model for the fate of toxic substances in the Great Lakes was completed, including estimates for system response times. Cerio daphnia chronic-effluent-toxicity tests were conducted on 14 pulp and paper and three municipal discharges. Four of the discharges were found to be toxic using this screening bioassay.

Measurements in tributary rivers and streams indicated that the Fox River contributes one-half of the aquatic input of PCBs to Lake Superior. Mass-balance input calculations have been completed for all the major streams entering the lake.

Methods to culture larval walleyes in the laboratory have been established. Studies have indicated that among a sub-sample of younger female walleyes, there appears to be no effect of xenobiotic chemicals upon survival of their offspring from the lower Fox River and Sturgeon Bay, Lake Michigan, Wisconsin.

Sludge

Criteria Profile Documents are being produced in support of new technical regulations for sludge. The purpose of the documents are to present information that can be used for the calculation of "hazard indices." Included were cancer data (potency estimates) and oral chronic toxicity data used in the quantification of hazards in the food chain, and inhalation and aquatic toxicity used in deriving hazard indices for the incineration and ocean disposal of sludges. The use of mutagenicity data has not yet been determined.

A major accomplishment for the Office of Health Research was the Municipal Wastewater Sludge Health Effects Research Planning Workshop. The implementation plan for the Sludge Health Effects Research Program was based

on the recommendations of the Sludge Workshop. A journal article was published entitled "Identification of a Mutagenic Compound in Municipal Sludge: Benzothiozine."

The engineering research program provided support to the development of sludge regulations and conducted five Regional seminars on municipal sludge composting and incineration.

A "Process Design Manual for Land Application of Muncipal Sludge" developed by the engineering research program was published, encompassing all aspects of land use and disposal including agricultural use and landfill. The Manual, with a distribution in excess of 5,000, is expected to be the definitive design reference for many years.

In order to provide accurate cost-benefit determinations for both land and ocean disposal of sludge, a computer program was developed for estimating costs of all reasonable disposal and utilization approaches. The program adds to EPA's CAPDET system for determining wastewater treatment plant capital and operating costs. A summary manual is being produced that will make this information more generally useful by presenting it in the form of charts and tables.

An EPA-funded engineering demonstration at Indianapolis showing the advantages of carefully controlled operation of incineration produced dramatic results. The method, which combines instruction with careful control of excess air and temperatures, can reduce fuel consumption by 50% and also reduce particulate discharges. Costs of the program are low, requiring only some upgrading of the instrumentation and training for the operators. This fuel-efficient operation is now in use at a dozen communities, with an average annual savings of $500,000 per year each.

Wastewater Technology

The major support areas focused on innovative/alternative (I/A) technology, engineering assistance, municipal compliance achievement and treatment plant upgrading, and toxics reduction and treatability for both municipal and industrial discharges. Policy and regulatory areas for which technical support was provided included the National Municipal Policy, Effluent Guidelines Promulgations, I/A Provisions of the 1981 Construction Grant Amendments, and the Policy for the Development of Water Quality-Based Permit Limitations for Toxic Pollutants.

Major accomplishments included eleven Regional seminars on "Innovative and Alternative Technology" and three state seminars for Region 6 on "Low Cost, Low Energy, and Low Operation of Municipal Treatment Facilities" in support of the National Municipal Policy. A major technical assistance effort was initiated with Region 3 and the states of Maryland and Virginia on municipal and industrial toxicity reduction and innovative nutrient control of point sources to support the implementation phase of the Chesapeake Bay Program. A Toxic Pollutant Workshop involving OW and the ORD water

laboratories developed an integrated ORD-wide research strategy on the water quality-based approach to control toxic pollutants. A major field study was completed involving COD removal in pharmaceutical wastewaters to support Effluent Guideline Regulations. The GC/MS tape work was continued to identify additional toxic pollutants that were not included on the initial list of the 129 "priority pollutants." This information will help identify industrial toxic pollutants of national concern.

Several health research publications have been completed: Health Effects of Land Treatment: Toxicological has been sent to the printer, and reports on aspects of the Lubbock and the Israeli wastewater epidemiological studies were presented at the Reuse Symposium in San Diego.

Quality Assurance

ORD continued its quality assurance (QA) efforts in support of the various parts of the water program.

Drinking Water. The Environmental Monitoring and Support Laboratory (EMSL) in Cincinnati maintained and distributed 55,000 quality control and performance evaluation samples (PE) and 5,000 calibration standards to Regional Offices, States, and local and EPA contract laboratories for use in their daily QA programs.

Inter-laboratory methods studies for trihalomethanes and purgeables were completed, as were the testing of draft methods for chlorates and the aggregate of chlorite, hypochlorite, chlorine and chlorine dioxide. These studies validate the methods so they can be used as national standards in drinking water treatment. Inter-laboratory studies also provide multi-operator precision and accuracy estimates for draft methods.

Extensive revision of the section on "Methods for Metals Analyses" for the course manual on "Drinking Water Chemical Laboratory Certification" was completed. This course was offered to 25 State and Regional persons in June. A companion course, "Drinking Water Microbiological Laboratory Certification," was developed and presented to 29 participants.

The repository of calibrated radionuclide standards and reference materials was maintained and upgraded by EMSL-Las Vegas. In excess of 600 of these standards and reference materials were distributed to federal, State, and private laboratories involved in monitoring drinking water supplies.

Also, intercomparison studies involving the measurement of radionuclides in water were conducted. Two performance evaluation studies, involving the measurement of a complex mixture of alpha, beta, and photon emitters, were also completed. Nineteen on-site laboratory evaluations were conducted in response to regional requests.

Municipal and Industrial Wastewater. Two major QA efforts were provided in 1984: the Quality Assurance Sample Repository was maintained to provide reference samples to EPA and State laboratories and support was provided to

the Office of Water Enforcement and the Regions in evaluating the quality of the data provided in the self-monitoring Discharge Monitoring Reports of the National Pollution Discharge Elimination System.

Water Quality. ORD completed a report on the quality control sample program, repository standards and continued to provide performance evaluation samples to support ambient monitoring and the permit program. A report was published on "Methods for Measuring the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms" and the U.S. EPA Manual of Methods for Virology was completed. Work was also completed on methods for organic analysis of municipal and industrial wastewater and interim methods for sampling organic pollutants in sediments.

In November 1983, EPA issued a Dioxin Strategy. The Strategy provides a framework for action that EPA, in coordination with other Federal and State Agencies, will be taking in response the concerns about the health risks from exposures from dioxin contamination in the United States. A critical part of the survey was the urgent and paramount need by EPA for chemical analysis for dioxin and furans in environmental samples at the part per trillion (ppt) and part per quadrillion levels (ppq). This concern was exemplified in that there are only a few contract laboratories in the U.S.A. that are experienced at these low trace analysis levels of environmental samples, and none of these laboratories had the capacity to handle the large number of samples required by the National Dioxin Survey. Moreover, validated methods for most of the sample matrices did not exist for trace analysis at the ppt and ppq level.

Considering the urgent need, the Office of Research and Development in concert with the Office of Pesticide Programs (OPP), proposed an approach to the Office of Water, that would meet EPA's short-term and long-term analytical needs. The approach, first organized the existing dioxin analyses expertise and state-of-the-art of equipment in a manner that would permit EPA to be operational early in Fiscal Year 1984. In the longer term, ORD would work with the contract laboratory certification program to bring the contract laboratories on line as soon as possible.

Conclusion

In summary, 1984 was a productive year for water research. The support base from this program reaches into all parts of the Agency as well as other Federal and State organizations. The EPA report to Congress entitled "Long-Range Research Agenda for 1986-1991" will provide additional information on emerging issues and research plans affecting water research.

1986 STRATEGIC WATER RESEARCH ISSUES

ISSUES	QUESTIONS	RESEARCH PRIORITIES '86	LONG-TERM RESEARCH NEEDS
1. Ocean Disposal	What information and methods should be used to predict and evaluate the impacts of ocean disposal practices?	*Increase*—Thru 1987 with emphasis on impact monitoring.	*Level*—Solid science base will support regional decisions. Additional increases may depend upon impact of the interior MOU.
2. WQBA/Permitting	What information and methods are needed to assure that the permitting process protects freshwater ecosystems and human health and how can we improve our fundamental understanding of the toxicity of man-made chemicals on aquatic life?	*Level*—Emphasis on controlling complex effluents. Field testing is needed to assess limits of permits.	*Level*—A continuous program for a long-term problem.
3. Great Lakes Research	What are the measures to understand and eliminate contaminant problems identified as areas of concern on the Great Lakes?	*Level*—Fulfill current commitments on toxics and modeling.	*Decrease*—As Regional program solves high priority problems.
4. Health Effects of Drinking Water Contaminants	What health effects are caused by chemical and microbiological contaminants found in drinking water?	*Level*—A high priority program which is adequately funded.	*Level*—This is a long-term priority and a difficult problem.
5. Groundwater	What is needed to improve monitoring and prediction of the nature and extent of problems by groundwater contamination including reclamation?	*Increase*—The extent of this problem is just now being documented. A major Agency strategic priority.	*Level*—Clean up and restoration of aquifers—currently at an embryonic state of knowledge.
6. Drinking Water Technology	What technology is needed to assure the safety of drinking water?	*Increase*—Emphasis on distribution problems and more cost effective treatment for toxic contaminants.	*Level*—Emphasis on assisting States and municipalities with compliance problems and evaluating treatment technology for newly regulated contaminants.
7. Sludge	What research information is needed to develop and assist in the implementation of sludge disposal regulations?	*Increase*—This is a serious national problem in need of applied solutions.	*Level*—Sludge management techniques are being developed in support of regulations.
8. Wastewater Treatment Technology	What information and technologies are needed to improve reliability and cost-effective upgrading and construction of municipal wastewater facilities and assure industrial wastewater treatment compliance?	*Level*—I/A technologies need to be evaluated, existing facilities upgraded and both industrial and municipal plants brought into compliance.	*Level*—Continue to evaluate innovative technologies for energy and cost efficiency.
9. Quality Assurance	To what extent can data collection and reduction methods be standardized to assure data reliability, repeatability, intercomparability, and scientific credibility?	*Increase*—The base QA program must assure EPA's ability to document data quality. Current levels are inadequate to do this. Emphasis will be on standardization of procedures and maintenance of QA repository.	*Level*—The QA effort will continue to track scope of environmental monitoring effort, both research and operational.

MAJOR EPA WATER RESEARCH LABORATORIES

Laboratory	FY-84 Resources FTE	R&D $(000's)	Main Area
Environmental Criteria and Assessment Office (Cin., OH)	11.0	0.2	Risk Assessment Support
Environmental Monitoring and Support Laboratory (Cin., OH)	62.2	1.33	QA and Analytic Methods - Drinking Water, Water Quality, Industrial Wastewater
Environmental Monitoring and Support Laboratory (Las Vegas, NV)	12.8	0.8	Groundwater and Water Quality Monitoring Methods
Health Effects Research Laboratory (RTP) Toxicology and Microbiology Division (Cin., OH)	87.3	6.6	Health Effects of Contaminants in Drinking Water and Ambient Water, Sludge Health Effects
Municipal and Industrial Environmental Research Laboratories (Cin., OH)	85.0	7.6	Treatment of Drinking Water and Municipal/Industrial Wastewater
Robert S. Kerr Environmental Research Laboratory (Ada, OK)	24.5	3.5	Fate and Transport -Contaminants in Groundwater and Land Application of Municipal Wastes
Environmental Research Laboratory (Athens, GA)	27.7	0.4	Water Quality Modeling and Composition of Complex Industrial Wastes
Environmental Research Laboratory (Corvallis, OR)	49.5	1.2	Use Attainability Sediments, Site-Specific Criteria
Environmental Research Laboratory (Narragansett, RI)	48.4	0.5	Marine Research
Environmental Research Laboratory (Duluth, MN)	52.0	1.9	Site-Specific WQ Criteria, Complex Mixtures, Integrated Methods for WQ Based Permits

HAZARDOUS WASTE/SUPERFUND RESEARCH COMMITTEE

ANNUAL REPORT

In order to develop a cohesive and responsive research program that satisfies the requirements of the Office of Solid Waste and Emergency Response, the Assistant Administrator for Research and Development and Solid Waste and Emergency Response identified the research issues being addressed by the Hazardous Waste/Superfund research programs. What follows below is a summary of the research efforts addressing these issues together with a statement of the overall status of each. Specific research outputs supporting each issue are contained in the appendix. These are organized for both the completed year 1984 and projected for the current year 1985.

WASTE IDENTIFICATION: What new analytical methods are needed to identify hazardous wastes and their chemical constituents?

Purpose

Analytical methods that are to be used to enforce Section 3001 of RCRA must be standardized and tested to determine their validity and reliability. New methods and procedures for detecting the presence of hazardous wastes under field conditions are also required to satisfy Section 3013 of RCRA which establishes facility monitoring requirements.

Projected Program

There are over 100 methods in SW #846. These methods require validation before they can be used in implementing the RCRA Program. We expect to fully validate ten methods by the end of 1986. Moreover, because of shortcomings in existing methods, up to eight new analytical methods are being developed. In order to accelerate both the methods validation process and the development of new methods, an innovative "generic" approach to both is being explored. Generic methods entail use of microprocessor controlled instrument systems and data system combinations which have the capability of analyzing large numbers of different samples and analytes rapidly.

State laboratories will play an increasing role in the analysis of environmental samples in response to RCRA requirements. In order to improve and upgrade their capabilities to conduct these types of analyses, and improve the quality of their data, an improved technical assistance program will be conducted.

Ground water contamination detection monitoring methods are being developed. These include such techniques as compound-specific in-situ sensors which use fiber optics technology; implanted water impermeable tubes coupled to organic vapor sensors; unsaturated zone monitoring methods; and indicator parameters of hazardous constituents. Viable techniques will

be validated and monitoring networks will be designed for landfills and for leaking underground storage tanks (LUST). Techniques recommended for use will be cost-effective and will provide near real time data in the field. This is a new effort and will probably require several years to produce field useable equipment.

Because many of the 275,000 Subtitle D, non-hazardous landfills are suspected of generating hazardous leachates which escape to contaminate groundwater, there is significant concern regarding the quality of data available for these facilities. Consequently, the monitoring data being collected at Subtitle D facilities will be identified and its quality evaluated. Information deficiencies will be identified and recommendations for new data collection procedures will be developed.

HIGH-HAZARD WASTES: What new information is needed to evaluate and control high-hazard wastes and to implement the National Dioxin strategy?

Purpose

The Agency's National Dioxin Strategy, published in December 1983, provides a framework for expansion of the information base required for a detailed assessment of the extent of dioxin contamination, associated health and environmental impacts, and recommends appropriate control actions that entail control technology research and development. The document also make reference to dioxin-like compounds. This program also addresses research and evaluation of technologies to detoxify or decontaminate dioxins (TCDDs) and dioxin-like materials, such as halogenated furans (PCDFs), ethylene dibromide (EDB), penthachlorophenol (PCP), and the like. It also contains research on analytical methods, quality assurance procedures and monitoring strategies and research on dioxin's environmental transport and fate.

Projected Program

Over the past three years research has focused on development of chemical and biological methods for in-situ destruction of PCBs, PCDDs (dioxins) and other representative halogenated toxic wastes. Methods are needed to cleanup waste-contaminated soils where conventional methods cannot be used. Effective dehalogenation reagents proposed from potassium and polyethylene glycols (KPEGs) have been used to treat various wastes but only at lab scale. Future direction of this research will be dependent on results of a peer review scheduled for late June 1985. Successful laboratory studies on high hazard destruction should be validated by small scale field verification studies. This phase is long range and will be addressed in the next two to four years.

The following research efforts have been initiated: Development of tests to assess the health hazards associated with dioxins; research to determine the rates of movement and transformation of dioxin in soil and ground water, and; research defining the potential biomagnification of

dioxins in food chain systems. For the next one to two years emphasis will be on assessing the health hazards of additional dioxin isomers other than 2,3,7,8-TCDD and further exploration of dioxins's bioavailability. The scope and length of these efforts will depend largely on the findings of the National Study and the Agency's subsequent position. Studies on 2,3,7,8-TCDD and other isomers will indicate mobility in soils, uptake in plants, fish and large animals by 1987.

Waste Characterization: What health and risk assessment information procedures are needed to characterize wastes and assess the hazards they represent?

Purpose

Waste characterization is the estimation of the hazards to public health and the environment a waste and the management practices associated with it represent. This information is needed for developing and revising regulations, permitting and enforcement decision-making and regulatory policy-making. Products of this research will provide more applicable, less expensive, simpler and more accurate information and risk assessment methodologies.

Projected Program

The processes and effects research program is structured to address problems associated with assessing the environmental toxicity of hazardous wastes, and assessing land disposal sites. Specifically, methods such as quantitative structure activity relationships (QSAR) will make possible the prediction of toxicity and bioaccumulation potential of wastes and leachates proposed for listing under RCRA Section 3001 on the basis of chemical molecular structure. Other studies are examining the use of microcosms as screening methods for assessing the pollution potential of wastes proposed for listing; developing and field evaluating mathematical models to predict environmental concentrations of wastes; developing and field evaluating a protocol to aid in identifying safe land disposal sites, based on subsurface characteristics and potential for ground-water contamination, and; testing and field evaluating a multimedia bioassessment protocol for determining bioavailability and toxicity of hazardous materials.

From these efforts, a number of useful outputs are anticipated. A model based on QSAR techniques is expected to be able to predict toxicity of individual chemicals by the end of 1986 and of chemical mixtures by the end of 1987. The technique for determining transport and fate parameters of wastes proposed for listing should be available in late 1988. Evaluation and additional development will result in a revised multiple bioassay screening protocol for assessing hazardous waste sites by the end of 1986.

Scientific assessments research is preparing Health and Environmental Assessment documents at varying levels of detail for specific chemicals found at hazardous waste sites. Also, assessment methods are being revised to reflect recent developments in toxicology and exposure evaluation. The

information available in these documents is used by OSW in making listing and other regulatory decisions and will therefore continue for several years to come. Health effects research is developing short-term in-vivo and in-vitro bioassays for evaluating waste streams to determine if they are hazardous and should be listed under RCRA. Screens are being developed to detect the following health effects: general toxicity; carcinogenicity; mutagenicity; immunotoxicity; neurotoxicity; teratogenicity, and; reproductive effects. Unlike the health effects documents mentioned above which rely on existing health information, these bioassays will generate new health information for specific waste streams and will offer an alternative means of supporting listing and other regulatory decisions.

ALTERNATIVE TECHNOLOGY: What technical information is needed to develop, evaluate, and permit alternatives to land disposal of waste?

Purpose

Provide support to OSW for implementing the new RCRA amendments for banning wastes from land disposal by evaluating and developing alternative technologies.

Projected Program

This is a relatively new program area for OSW and for ORD. Past research emphasis was on developing innovative or emerging technologies for treating wastes where currently available technology is inadequate or not cost effective. This innovative technology research focused on new thermal processes (e.g., plasma arc, wet oxidation), biological processes, and chemical treatment for heavy metals removal. Although this earlier program is still underway, in 1984 a revised program was initiated to conduct performance evaluations of existing treatment systems because of the RCRA amendments banning certain wastes from landfills. In this program area, OSW's needs are urgent. During the next two to three years, processes will be identified, evaluated, and directed toward specific waste streams. The ability of treatment systems to handle priority wastes must be quickly assessed and all residuals characterized. Mechanisms must be developed through which the widespread adoption of these environmentally preferable processes can be encouraged. There will be great emphasis on technology transfer activities in 1986 and beyond.

LAND DISPOSAL: What technical information is needed to support permitting of land disposal facilities?

Purpose

This research program is directed at developing better design and operation technology for land disposal systems and the ability to optimize designs, minimize maintenance and overall costs while maintaining a high

degree of confidence that the waste management facility will operate as designed. This research will provide guidance on design, permitting, operation, maintenance, closure and regulation of hazardous waste treatment, storage and disposal facilities.

Projected Program

Laboratory and pilot plant studies to date have resulted in technical resource documents containing information regarding the design and permitting of engineering components of landfills and surface impoundments. These include cover systems, clay and synthetic-liners, leak detection devices and leachate collection systems. Future research efforts will focus on field validation of existing design data, special engineering requirements for surface impoundments, sophisticated design features such as double liner systems, land disposal of "non-hazardous" (Subtitle D) municipal and industrial wastes, and the management of high volume mining wastes. These additional efforts are specifically mandated by the RCRA amendments of 1984 in an effort to improve the safety and efficacy of existing and future land disposal facilities. It is anticipated that a construction quality assurance manual incorporating engineering data related to dike stability, double liners, and other updated components will be available in approximately two years.

Research on land treatment of wastes is demonstrating the degradation, transformation and immobilization of hazardous chemicals using natural chemical and biological processes. Various aspects of land treatment, such as effects of rate and frequency of loading on organics degradation, monitoring for hazardous constituents in the unsaturated zone and land treatability of listed wastes will be reported on in stages over the next three years.

CONTROL OF HAZARDOUS RELEASES: What techniques are needed to adequately prevent, contain and clean up accidental discharges of hazardous materials?

Purpose

Accidental releases of oil and hazardous material to the land and water occur frequently and constitute a significant environmental hazard. The Clean Water Act and CERCLA mandate that EPA engage in such research studies, experiments and demonstrations as appropriate to prevent, control and eliminate pollution caused by the release of hazardous materials into the environment. The object of this research program is to develop technical information and guidance to be used by response teams in responding to, controlling and abating emergency hazardous releases; concentration and separation of spilled materials; and a limited effort on destruction and disposal of residuals from cleanup operations. Current and future research will include a continuation of ongoing activities with special emphasis on development of on-site permanent disposal or destruction of the residuals collected from cleanup operations and restoration of the impacted area to its pre-contaminated condition. This aspect of the research program is of major importance due to the significant difficulties associated with transporting hazardous

materials off-site and the problems associated with using landfill sites for "final" disposal of the cleanup residuals. In approximately two years the program will yield sufficient research results to allow for field use of new physical and chemical methods of on-site destruction and detoxification of released materials, including the application of dispersants for water borne releases.

INCINERATION: What technical information is needed for permitting incinerators and revising RCRA regulations?

Purpose

OEET is conducting research on thermal destruction technologies for hazardous waste in order to provide the technical basis for establishing and improving regulations for the thermal destruction of hazardous wastes. EPA, Regional, State and local permitting officials also need the outputs from this program to enhance their understanding of the criteria involved in evaluating the acceptability of incinerating some wastes and in monitoring operating combustion units for compliance with performance requirements. The program continues to investigate laboratory, pilot and full scale environmental performance issues on a broad range of incineration and other thermal treatment devices.

Projected Program

Research to date has concentrated on assessing the ability of existing thermal destruction facilities (incinerators and high temperature industrial processes) to meet RCRA performance standards for destruction and removal efficiencies for hazardous materials. These studies have resulted in an extensive performance data base which indicates that these facilities are capable of meeting RCRA standards under ideal conditions. Future research will concentrate on the development of engineering relationships for compliance monitoring and performance assessment; incinerator failure mode analysis; and development of simplified process measurement methodology. This method of attack is significant because there is a need for an easily measured engineering parameter to indicate adequate destruction of hazardous substances and thermal destruction devices are not always operated under steady state conditions. In approximately two years this research effort should result in compliance monitoring methods for field applications.

QUALITY ASSURANCE: What measures are needed to assure the reliability and consistency of techniques and data used in support of the hazardous waste program?

Purpose

A comprehensive quality assurance program will assure that data of known quality are being collected. This program is developing, evaluating,

and distributing analytical standards and reference materials to all participating laboratories. Quality control and performance evaluation samples are also being developed and distributed to appropriate laboratories. With the transfer transfer of permitting and enforcement from EPA to the States, quality assurance procedures will enable the States to perform the required measurements and monitoring functions. This will require some additional support to the State laboratories for instrument calibration and reference materials. The materials are replicates of RCRA Appendix VIII list of compounds. Of the 372 Appendix VIII materials, 312 are currently available. Over 200,000 quality control samples were distributed to State, local, Agency and contract labs and approximately 42,000 calibration standard samples were distributed to 1330 users in FY '84.

Y105

SITE ASSESSMENT: What technologies and information are needed for the effective management of uncontrolled waste sites?

Purpose

The success of removal and remedial actions depends on the accurate definition of the nature and severity of the problem. This program is designed to provide the necessary techniques and procedures to allow on-scene coordinators to quickly and effectively assess the degree of hazard posed at specific uncontrolled waste sites.

Projected Program

Support to date has concentrated on engineering technical reviews and comments for assessing sites and situations. Future support will also concentrate on the assessing hazardous waste site situations but include additional considerations such as waste characteristics, hydrology, geology and soil characteristics. The objective is to assist Regional Office Superfund staff, EPA Zone Contractors and State Superfund Offices in the development of corrective measures which significantly improve the quality of remedial work while reducing the cost of the Superfund program nationally. We predict that in approximately three years these new assessment criteria should have a beneficial impact on the remedial program.

Site specific risk assessments covering single chemicals and sample mixtures have been provided to OERR and the regions for use in pre-remedial decision making. The rapid response health assessment system has been expanded and assessments using this system have been provided for use in deciding appropriate response to emergency situations. Future responses will require an increased number of site and chemical specific health assessments for the program office and enforcement. Procedures for estimating emissions of low vapor pressure compounds, such as dioxin, from landfills are also being revised. These procedures will provide on-scene coordinators with refined methods for assessing the degree of human hazard

posed at or near specific uncontrolled waste sites contaminated with hazardous substances. This effort will be ongoing for several years.

PERSONNEL PROTECTION: What technical information is needed to ensure the health of waste site personnel?

Purpose

Information on personnel health and safety equipment and procedures is being developed through evaluations and assessments of technical components in order to ensure protection during removal and cleanup operations.

Projected Program

Research is currently addressing EPA needs relating to (1) the acquisition and analysis of chemical protective clothing performance data, (2) development and verification of protective test methods, (3) estimating protective clothing performance, and (4) evaluation and improvement of self-contained chemical protective ensembles. These investigations, which are being conducted in support of TSCA-, FIFRA-, and CERCLA mandated programs will result in data, methods, procedures, and equipment that will enhance the safety, increase the range, improve the flexibility, and decrease the cost of EPA or contractor operations at chemical spills and uncontrolled hazardous waste sites.

Shakedown evaluation of the long-term, self contained chemical protective emsemble (LSCPE) is scheduled for completion within the next two years. Additionally, several workshops dealing with personnel protection research needs will be implemented over the next two years. Moreover, as protection technology continues to improve, there will be a continuing need to assess personnel protective equipment and to develop potential remedies for any deficiencies.

TECHNOLOGY EVALUATION: What technologies and information are needed for effective management of uncontrolled waste sites?

Purpose

Technologies, techniques and construction materials are being evaluated for cost effective control of uncontrolled hazardous waste sites. Reports, manuals, and handbooks are being prepared to provide design and operational data, and cost effectiveness information for decisions affecting removal and remedial actions.

Projected Program

Research needed to provide performance and cost data for remedial and response technologies must continue to be provided by testing available and approved technologies under controlled-conditions and at sites-of-opportunity. Since funding levels for developing new EPA remedial and removal technology have not kept pace with the current field needs, other means must be devised by EPA to provide the user community with these much needed answers on a timely basis. Government-sponsored evaluations of privately developed technologies undertaken with controlled, reproducible conditions, offer a strong incentive toward commercial stimulation of new technology and a potential solution to this problem. Future EPA research in technology development will be directed toward objective evaluation of commercially available, innovative technologies which can be applied to the Agency's emergency response and remedial activities. Moreover, we are also moving away from research on containment technologies to areas which show promise for eliminating the problem on-site. Since most of the currently available cleanup technologies have been developed in other areas (e.g., construction and nuclear waste disposal fields) and have not been field evaluated at uncontrolled hazardous waste sites, evaluation of these technologies will require from three to ten years to obtain verifiable results. Activities involving field evaluations of EPA developed equipment, such as the mobile incineration system and mobile soils washer will be completed and the equipment reduced to practice within three years.

TECHNICAL SUPPORT: What technical support is required by Enforcement, the Regions and the Program Office for effective implementation of the Superfund program?

Purpose

The purpose of this effort is to provide Enforcement, Regional and Program Office personnel with the expert advice and technical information required to effectively implement the Superfund program.

Projected Program

As the number of Superfund field actions increases, so will the need for scientific, state-of-the-art support. Support activities will include: site and chemical specific health risk assessments; expert witness testimony during legal actions; reviews of remedial action designs, and; reviews of data submitted by liable parties.

APPENDIX

Waste Identification

Projected 1985 Outputs

- Evaluation reports on four SW-846 analytical methods.
- Evaluation report on the Volatile Organic Stack Sampling Train.
- Report on selecting indicator parameters for subsurface monitoring.
- Report on vadose zone monitoring of land treatment facilities.

Results of Previous Fiscal Year

- Interlaboratory evaluation of standardized Ames test procedures.
- Report on downhole geophysical monitoring of groundwater contamination.
- Workshop to determine the monitoring requirements for Subtitle D landfills.
- Evaluation of several SW-846 analytical methods.

High Hazard Wastes

Projected 1985 Outputs

- Final report on in-situ stabilization of dioxin-contaminated soils.
- Final report on use of abandoned mines for ultimate disposition of dioxin-contaminated soils.
- Interim report on field application/feasibility of APEG reagents for dioxin-contaminated soils.
- Interim evaluation report of EPA mobile incinerator on southwestern Missouri dioxin-contaminated wastes and soils.
- Standard analytical method and quality assurance reagents to support routine analysis of trace quantities of 2,3,7,8-TCDD at hazardous waste sites.
- Evaluation of the RCRA low resolution screening method for dioxin determination in wastes.

Results of Previous Fiscal Year

- Final peer-reviewed report, desorption characteristics of 2,3,7,8-TCDD in contaminated soils.
- Final internally peer-reviewed report, assessment of PCDDs and PCDFs from PCB transformer and capacitor fires.
- Sampling and analysis guidance documents.
- Quality assurance reference standards for 22 tetra dioxin isomers.
- Round robin survey of major trace analytical methods to detect dioxins and related compound in adipose tissue.
- Standard high resolution analytical protocol for trace analyses of 2,3,7,8-TCDD were initiated.
- Study to determine the pharmacokinetics of dioxin in Rhesus monkeys, including transfer to offspring through mother's milk.

Waste Characterization

Projected 1985 Outputs

- Health and environmental effects profile on up to 180 chemicals.
- Report on the hydrogeological classification protocol.

Results of Previous Fiscal Year

- Report on the joint action of multiple organic toxicants to freshwater organisms.
- Report on the proposed in vivo/in vitro approach to toxicological assessments of hazardous wastes.
- Short-term bioassays were shown to be useful in evaluating the environmental impacts of land treatment of industrial wastes.

Alternative Technology

Projected 1985 Outputs

Results of Previous Fiscal Year

- Report on emerging thermal technologies.
- Report on recovery and recycling of metals from plating and chemical wastes.
- Report on assessment of hazards from PCB transformer fires.

Land Disposal

Projected 1985 Outputs

- Report on clay liner ability to retain/retard, organic and inorganic landfill pollutants.
- Report on organic wastes modification procedures for stability and durability.
- Report on updated status of underground storage of hazardous waste.
- Report on VOC emissions from waste disposal facilities and applicable control technologies.
- Interim report on effects and control of subsidence on landfills covers.

Results of Previous Year

- Completion of the Hydrologic Evaluation of Landfill Performance (HELP) Model for rapid estimation of amounts of leachate, drainage, runoff and head buildup on liners and covers in landfills.
- Completion of a study of the relative effectiveness and durability of a wide variety of synthetic liner materials under conditions simulating those of actual waste storage and disposal.
- Completion of pilot tests of three innovative techniques designed to detect and locate leaks in geomembrane liners used to line hazardous waste units.

Hazardous Releases

Projected 1985 Outputs

- Report on the design of impoundment/waste lagoon leakage controls.
- Technical handbook on hazardous substances release prevention.
- Report on the evaluation of concentration techniques using sorbents for control of hazardous materials.
- Analysis techniques for remote monitoring data for spill and emergency on-scene coordinators.
- Aerial photography collection and interpretation for the SPCC program.
- Chemical-specific health summaries.

Results of Previous Year

- Preparation of EPA's mobile incineration system for field treatment of dioxin contaminated soils and liquids.
- Field testing of EPA's mobile carbon regeneration system.
- Preparation of a guidance manual for the control of lagoon overflows.
- 10 Regional SPCC studies.
- 25 emergency studies.
- Review of analytical techniques for color photography.

Incineration

Projected 1985 Outputs

- Interim report on incinerator operating parameters which correlate with performance.
- Report on impact of transient feed and inadequate combustion chamber mixing as causes of incinerator failure.
- Interim report on evaluation of transient nonsteady-state performance of hazardous waste destruction in boilers.

FY 84 Results

- Performance evaluation of full-scale hazardous waste incinerators.
- Report on waste oil combustion tests in support of the waste oil RIA.
- Report on engineering assessment of hazardous waste destruction in industrial boilers.
- Report on pilot-scale incineration of chlorinated benzenes at the combustion research facility.

Site Assessment

Projected 1985 Ouputs

- Survey and case studies to provide an understanding of remedial options. These case studies analyze the remedial actions from the perspective of technology costs, planning and management.

- A geographic information system for NPL sites. This system will centralize geographic source data and manipulate the information to analyze and prioritize clean up operations.

- Guidelines for measuring pollution in sediment and ground water.

- Rapid response health assessments for use in deciding appropriate response to emergency situations.

- NIOSH certification report on the EPA/Army IAG developed long-term self contained chemical protection ensemble (LSCPE).

- Evaluation report the permeability of the chlorinated polyethylene protective suit fabric.

- NIOSH testing of the breathing apparatus for the LSCPE.

Results of Previous Year

- Five LSCPE breathing apparatuses and the technical data package were completed and submitted to NIOSH for review.

  A Manual of Practice for Marine Safety Officers and on-Scene Coordinators Involved in Chemically-and/or Biologically - Contaminated Underwater Operations: Interim Protocol was completed and forwarded for EPA administrative review.

- Guide for decontamination of buildings, structures and equipment at Superfund sites.

- Handbook of leachate plume management, including factors which affect migration and techniques for control.

- Technical handbook for stabilization and solidification alternatives for remedial actions at uncontrolled hazardous waste sites.

- Evaluation of the mobile incinerator for burning dioxin-contaminated liquid wastes and soils in Missouri.

- Shakedown evaluation report on an in-situ treatment system.

- A report on chemical countermeasures involving water flushing with additives to decontaminate soils in-place.

- Handbook on slurry trench construction for pollution migration control.

- Technical document on in-place treatment techniques for contaminated surface soils.

- Numerous activities (e.g., obtaining necessary permits for Region VII operation; development/testing of a solids feeding system; etc.) were accomplished in order to prepare the incinerator for field operations with dioxin-contaminated liquid wastes and soils in Missouri.

- A multi-phase testing program was conducted to provide comprehensive data on the performance capabilities of the mobile carbon regeneration unit.

Results of Previous Fiscal Year

- A workshop to determine the requirements for monitoring and management of hazardous waste at non-hazardous, Subtitle D facilities.

- Several monitoring techniques were evaluated, including one for downhole geophysical monitoring of groundwater contamination.

- Several SW-846 analytical methods were evaluated.

Projected 1985 Outputs

(Will be similar to those presented below)

Results of Previous Fiscal Year

Typical technical assistance activities during FY 84:

- Assistance to Region 6 in the development of an extinguishment plan for subsurface fires at the Compass Industries Landfill.

- Assistance to Region 5 and the Minnesota Pollution Control Agency on the containment of organic contaminated groundwater by the peat bed deposits underlying the Reilly Tar and Chemical Landfill Site.

- Expert witness testimony on the Vertac site in Jacksonville, Arkansas related to appropriate cover systems for remedial action.

- Technical analysis and on-site inspection of the Iron Mountain Superfund site in California as part of the conduct of the remedial investigation and feasibility study.

- Technical analysis of the feasibility study and remedial action plan for the Petro-processors site in Scotlandville, Louisiana.

- Settlement agreement QA/QC support to Region 2 on the Occidental sites in the Buffalo, N.Y. area.

- Data audits for String Fellow and Vertac programs.

- Sampling and monitoring support for Region 3,7,and 10.

- Three technology transfer seminars for field sampling.

PESTICIDES AND TOXICS RESEARCH PROGRAM

THE 1984 ANNUAL REPORT

The purpose of this report is threefold: (i) to identify the major purposes and thrusts of the research program, (ii) to identify the research results of use to OPTS available in the foreseeable future and (iii) to identify the research results of use to OPTS made available in FY 1984. This report is not intended to provide a comprehensive outlook or strategy for pesticides and toxics research, but to provide a short, coherent and cogent review.

Purposes and Thrust

The ORD research program in pesticides and toxic substances supports OPTS in three ways:

i. ORD researches test methods that OPTS can then prescribe to manufacturers and others for submission of data to EPA. Such data results of tests include the areas of health effects, environmental effects, exposure, transport and fate.

ii. ORD performs research so that OPTS can make more plausible estimates of risk to both humans and the environment from the above types of data, to ensure that OPTS regulatory and risk management actions are appropriate. Such research improves estimates of actual exposure and dose response curves.

iii. ORD provides a general support function for various OPTS needs. Major activities in this area include quality assurance support and support for the review and development of risk and exposure assessments.

The ORD resources devoted to these objectives were $28.3 million in FY 84 and expected to $36.2 million in FY 85.

Nine specific issues were identified for research support. These areas were chosen to meet three criteria: 1) The research, if successful, would enable OPTS to regulate and enforce better; 2) The research would address areas where regulation and enforcement are most effective in environmental improvement; and 3) The research efforts would be in an area with reasonable expectation of successful completion.

The nine research areas are:

1. Test Development

This work concentrates on the development of tests for the generation of prescribed data to be submitted by manufacturers, etc., to OPTS. This includes toxicology data, ecologic effects, exposure, transport and fate.

2. Health: Markers, Dosimetry, Extrapolation

This research focuses on (i) development of biologic markers for estimating exposure and for predicting chronic effects, (ii) techniques to more plausibly extrapolate from effects at high doses to those at low doses and to extrapolate data from non-human test systems to humans and (iii) studies on metabolism to improve both dose estimates and extrapolation.

3. Special Human Data Needs

The research includes epidemiology and clinical studies to evaluate the applicability of results obtained in animals from research on extrapolation, dosimetry and biological markers to humans.

4. Ecology: Field Testing and Fate

Research in this area focuses on:

i. the development of models to predict the transport, transformation and fate of chemicals (including pesticides) in the environment.

ii. the field testing and validation of models and of the test methods developed under other issues.

5. Ecology: Ecotoxicity and Risk Assessment

The research focuses on the development of a theoretical framework which can predict effects to an ecosystem (ecotoxicity) by integrating data on effects to organisms, the nature of the ecosystem, exposure, and transport and fate.

6. Engineering

These efforts examine chemical manufacturing processes to determine how and what amount of chemicals are released to the environment, as well as worker exposure. Additionally, manufacturing processes are being examined to

estimate the production and release of unwanted by-products and contaminants as well as how and in what amount these are released to the environment. Finally, research is being conducted to evaluate the effectiveness of protective garments worn by pesticide manufacturers, formulators and applicators.

7. Exposure Monitoring

This research focuses on the development of monitoring systems to estimate human exposure to chemicals in the environment. It includes the determination of what kinds of measurements are necessary, how many measurements, how they should be used to estimate exposure, and how the different measurements relate to one another.

8. Structure Activity Relationships (SAR)

This research focuses on the relationships of similarities of chemical structures to estimate toxicity (for both health and ecologic purposes), bioaccumulation, and transportation and fate properties. This research is in direct support of OTS premanufacture notification efforts.

9. Biotechnology

Biotechnology has been identified as a separate research issue due to the need for information on products being developed by this rapidly growing industry. Research will aim at defining health and environmental effects of concern, how to test for them, how to estimate risk, and methods to contain and destroy genetically altered organisms.

SIGNIFICANT OUTPUTS FOR PESTICIDES AND TOXICS RESEARCH (NEAR-TERM)

Test Methods Development

Health

i. Report defining the multi-end point (gene mutation, sister chromatid exchange, and chromosome aberration) of mammalian cell mutation systems with emphasis on the mouse fibroblast assay. (1985)

ii. Cytogenic methods for detecting chromosome damage in somatic cells of exposed humous. (1986)

iii. Development of two animal immunotoxicity assays; alveolar macrophage (AM) cytostasis and cytotoxicity; AM antigen processing, AM lymphocyte interactions, and local antibody production. (1986)

iv. Protocol for a rapid assessment of reproductive damage. (1986)

Environment

i. Report on critical responses of population of crustaceans to toxicants. (1985)

ii. Methods manual for spawning, culturing and testing antherinid fishes. (1986)

iii. Methods to assess effects of toxic chemicals on estuarine larvae. (1985)

iv. Techniques to evaluate effects of uptake of toxic chemicals from sediment by benthic organisms. (1986)

v. A low cost multiple species chemical screening test for ecotoxicology. (1985)

vi. Protocol and support documents for characterizing indirect photolysis of chemicals. (1986)

Monitoring Systems

i. Validation of supercritical fluid gas chromotography procedures. (1986)

ii. Standard procedures for measuring azo dyes in the environment. (1986)

iii. Development of gas chromatograph - fourier transform mass spectroscopy to detect toxic compounds in environmental matrices. (1987)

iv. Development of Raman spectrographic procedures for toxic compounds in environmental matrices. (1987)

v. Development of gas chromatograph-fast ion bombardment procedures to detect toxic compounds in environmental matrices. (1987)

vi. Development of monoclonal antibody procedures to detect toxic compounds in environmental matrices.

Health: Markers, Dosimetry, Extrapolation

i. Report on the tumor initiating, promoting and coinitiating activities of respiratory carcinogens. (1985)

ii. Report of predisposing factors to cancers of the respiratory tract. (1985)

iii. Report describing germ cell cytogenic test system giving new methods for detecting genetic damage. (1986)

iv. Extrapolation models for neurotoxic effects in humans using comparative neurotoxicologic data from a variety of species. (1990)

v. Report on plausible conclusion to be drawn from the large genetic toxic base. (1986)

vi. Report on reproductive hazards of pesticides. (1985)

vii. Report on the effects of toxic exposure during the development of sexual dimorphism. (1986)

viii. Report of possible conclusions to be drawn from analysis of the computerized genetic toxicology data base. (1986)

Special Human Data Needs

i. Proceedings of conferences on medical screening and biological monitoring for effects of toxicant exposure in the workplace. (1985)

ii. Evaluation of biomonitoring or screening methods for neuro-behavioral effects of toxicant exposure. (1985)

iii. Report on feasibility of using available biomonitoring and screening methods for estimating exposure and effects of toxicants on DNA and mutagenesis. (1986)

iv. Report of epidemiology study on sulfuric acid exposure and laryongeal cancer. (1989)

v. Report on epidemiology study with welder not exposed and asbestos and lung cancer. (1989)

vi. Report of epidemiology study on bladder cancer and the chemical MOCA.

Ecology: Field Testing and Fate

i. Report relating responses of single-species and benthic communities to toxic chemicals. (1987)

ii. Report comparing single-species and microcosms lab tests with pond studies using fluorene. (1986)

iii. Report on pharmacokinetic model of fish as a surrogate species for mammals in initial screening of PMN chemicals. (1985)

iv. Report on comparative sensitivity of larval stages of pelagic spawning estuarine fishes to toxic substances. (1986)

v. Report on use of persistence limits as management strategy for regulating toxic chemicals in marine ecosystems. (1985)

vi. Report on field validations of fate and effects of selected toxic chemicals derived from lab microcosms. (1985)

vii. Report on the applicability of terrestrial test methods for avian species to field populations. (1986)

viii. Journal article on SAR at the ecosystem level: single species relative tox. vs. ecosystem level tox. using microcosms. (1986)

ix. Final report on biodegradation predictions from microcosm fate, screening of eco-core system compared to field. (1985)

x. Report on mathematical models for transport and transformation of toxic chemicals in subsurface environments. (1986)

xi. Users manual for prototype, screening-level, multi-media environmental exposure model for organic chemicals. (1984)

xii. Users manual and support documents for EXAMS II. (1985)

xiii. Report on field evaluation of EPA reproductive test for avian species using Endrin. (1985)

xiv. Report on biota recovery of a freshwater pond after the application of Dursban (Pesticides). (1985)

xv. Final data report on field validation of freshwater hazard assessment methodology. (1986)

xvi. Report on hazard evaluations and relate field to laboratory data with proposal on how to test limits of applicability. (1986)

xvii. Report on field validation for predicting effects of Abate (Tempephos) on non-target organisms. (1986)

xviii. Dougherty Plain project report. (1985)

xix. Report on fate modeling and field applicability testing with pentachlorophenol. (1985)

xx. Journal Article - Kinetic models describing abiotic reaction of organic compounds in sediments. (1985).

xxi. (Prototype) Manual-design requirements for conducting field level pesticide runoff studies. (1985)

xxii. Draft users manual - simplified exposure procedures (nomograph-tables) to OPP based on HSP-F production runs. (1985)

xxiii. Journal article on results of field testing of PRZM and PESTANS-Leaching models for Coastal Plain soils. (1987)

Ecology: Ecotoxicity and Risk Assessment

i. In 1985 a research plan for this area will be made.

Engineering

i. A user manual on selecting protective clothing for pesiticide's applicators. (1986)

ii. Reports on IPPEU (Industrial Process Profiles for Environmental Use) for polymer processing (1985) and for plastics additives. (1986)

iii. Reports on preliminary assessment of and on sampling of chemicals. (1985)

Engineering Monitoring

i. Conduct a pesticides exposure study using the total exposure assessment methodology (TEAM). (1985)

ii. Validation of TEAM for organic compounds. (1985)

iii. Guidelines for validating multi-media exposure models. (1986)

iv. Establishment of the exposure monitoring test site. (1986)

v. Report of body burdens of organic based on DNA adducts. (1986)

Structure Activity Relationship (SAR)

Health

i. Report on azoreductose studies for hazard potential of azo compounds. (1985)

ii. Report on molecular electrostatic interactions and SAR methods. (1986)

iii. Provide combined data management system for genotoxic chemicals by matching activity profiles for short-term bioassays. (1986)

Ecology

i. Report on SAR relationships to estimate reactivity and product formation based on thermodynamic considerations. (1986)

ii. Journal article describing relationships between microbial degradation rate constants and chemical properties. (1986)

iii. Protocol and support document for estimating photochemical rate constants from chemical properties. (1987)

iv. Report describing SAR models for predicting the toxicity and uptake to terrestrial plants and animals. (1987)

v. Report on a comprehensive structure-toxicity method to estimate toxicity of chemicals to aquatic organisms. (1986)

vi. Report on SAR methods to predict mode of toxic action for PMN chemicals. (1985)

vii. Report on evaluation of SAR method for estimating physical/ chemical properties of industrial chemicals. (1985)

Biotechnology

Health

i. Report from a workshop on potential health hazards of genetically altered viri that are capable of infecting mammalian cells. (1985)

ii. Report of the recombination of DNA in plasmids and genomes of bacilli, including the Bacillus thuringiensis. (1987)

iii. Report characterizing the cytolytic factor of B. thuringiensis. (1986)

Environment

i. Report on data base for detecting, identifying and enumerating novel organisms in terrestrial environments. (1985)

ii. Report on identification and enumeration techniques for genetically altered microrganisms in complex environments. (1985)

iii. Report on genetic stability of altered genotype in complex ecosystem. (1986)

iv. Report on environmental factors which limit and control survival and growth of new genotype. (1986)

v. Report on testing techniques for effects of Biological control Agents on freshwater organisms. (1984)

vi. Progress report on pathologic, biochemical and genetic probes developed to detect BCA's in non-target hosts. (1984)

vii. Progress report on laboratory exposure on non-target aquatic animals to insect viruses. (1984)

viii. Report on field validation of test techniques for Biological control Agents of freshwater organisms. (1985)

ix. Report and laboratory testing and evaluation of selected Microbial Pest Control Agents on non-target birds. (1987)

x. Report and laboratory testing evaluation of selected Microbial Pest Control Agents on non-target Anthropods. (1987)

Significant Work Completed in FY 84

Test Methods Development

Health

i. A report reviewing the integrated use of various data for assessing the mutagenic risk of pesticides.

ii. A simple validated procedure for estimating sperm mobility.

iii. A report showing the importance of age in assessing neurotoxic effects.

iv. Effects of benomyl on male rate reproductive development for supplemental information for OPP testing guidelines.

v. Assessment of two methods for estimating dermal exposure to pesticides.

vi. Report on the Neuropathology of Trimethyl Tin on Neonatal Rat Hoppocampus.

vii. In Vitro Toxicity Screening Tests - A Comparison of Metabolic Activation Systems and Treatment Protocols Among Different Laboratories.

viii. Report on the Interaction Between Normal Human Diploid Cells and Chemical Carcinogens/Mutagens In Vitro.

ix. Report on Explant and Monolayer Culture of Human Broncial Epithelium in a Serum-Free Medium.

x. Report on a Rat Tracheal Cell Culture Transformation System for Assessment of Environmental Agents as Carcinogens and Promoters.

xi. Report on Utilization of Mammalian Specific Locus Studies in Hazard Evaluation and Estimation of Genetic Risk.

xii. Journal Article on Use of Human X Mouse Hybrid Cell Line to Detect Aneuploidy Induced by Environmental Chemicals.

xiii. Report on Dermal Absorption and Disposition of 1, 3-Diphenylguanidine in Rats.

Environment

i. Reports on early life test methods for marine fishes.

ii. Toxicity test methods and support documents for OPTS guidelines in several areas including seven-day life cycle cladoceran, a standard test practice for the use of brine shrimp as food for aquatic test animals, a root uptake test of phytotoxicity, etc.

iii. Interlaboratory evaluation of several tests completed including a sheephead minnow early life state toxicity, a stress ethylene bioassay for phytotoxicity, etc.

Monitoring

i. Development of luminescent method for measurement of organic compounds in the air.

ii. Many improvements for use with GC/MS and organic compounds.

Health: Markers, Dosimetry, Extrapolation

i. Report on 7, 12-Dimethylbenz (A) Antracene-DNA Adduct Formation in Spague-Dawley and Long-Evans Female Rats - The Relationship of DNA Adducts to Mammary Cancer.

ii. Report on Metabolism and DNA Adduct Formation of 2-Acetylaminofluorine by Bladder Explants from Human, Dog, Monkey, Hamster, and Rat.

iii. Report on Cross-Species Extrapolation and Hazard Identification in Neurotoxicology.

iv. Report on the effects of toxic exposure during development of sexual dimorphism - used to support OPP in its IAG with U.S. Department of Labor.

v. Teratogenic evaluation of the pesticides baygon, carbofuran, dimethoate and EPN. These data are used by OPP to assist in the extrapolation of animal data to humans.

vi. Effects of two pyrethroid insecticides on motor activity and the acoustic startle response in the rat 1, 2 - used to extrapolate animal data to humans.

vii. Interaction between hexachlorocyclohexane and the gastrointestinal microflora and their effect on the absorption, biotransformation, and excretion of parathion by the rat - data to be used to assist OPP in understanding the mechanisms of metabolism.

viii. Clastogenic and physiological response of chromosomes to nine pesticides in the vicia faba in vivo root tip assay system-used by OPP for assessing genotoxicity of pesticide chemicals.

ix. Chloridimeform produces profound, selected and transient changes in visual evoked potentials of hood rats - used by OPP toxicologists to evaluate data submitted by registrants to determine risks.

x. A report on an analysis of the spectra of genetic activity productive by known or suspected human carcinogens - used by OPP to support efforts in evaluating genetic effects.

Special Human Data Needs

No output in 1984

Ecology: Field Testing and Fate

i. A report for the dynamics and pathways of exposure of fish in the Hudson River to PCBs.

ii. A report on the exposure of fish, periphyton, and macrophytes to fluoresce, pentachloropheno, and atrozine and the resulting effects.

iii. A model, called MEXAMS has been developed for predicting exposure concentrations of metals in aquatic systems.

iv. A report on the effects of sediment micro-organisms on estuarine pesticide biodegradation.

v. Report on a method for predicting pesticide effects on non-target organisms in a freshwater pond.

vi. Study on the feasibility of using population-ecosystem models to evaluate chemical impacts in aquatic systems.

vii. Report of field study on aquatic animal pesticide accumulation.

viii. A manual for use of a model, called PRZM-1, to predict pesticide leaching potential.

ix. An evaluation of the EXAMS-II exposure model.

Ecology: Ecotoxicity and Risk Assessment

This is an FY 86 initiative and hence no outputs in FY 84.

Engineering

This is an FY 85 initiative and hence no outputs in FY 84.

Exposure Monitoring

i. Provided the soil sampling strategy for the Dallas lead study.

ii. Provided a protocol for vegetation sampling.

iii. Provided guidelines for exposure monitoring of well water.

iv. Designed an optimized air monitoring network for exposure assessments.

v. Performed a field assessment of lead contamination in Dallas.

Structure Activity Relationship (SAR)

i. In Vitro SCE and chromosome aberration Analyses in Mice Exposed to Dichloromethane.

ii. An Analyses of the Spectra of Genetic Activity Produced by known or Suspected Human Carcinogens.

iii. Journal Article on Pattern Recognition Analysis of a Set of Mutagenic Aliphatic Ni-Nitrosoamines.

MULTIMEDIA-ENERGY RESEARCH COMMITTEE

FY 1984 ANNUAL REPORT

Introduction

On behalf of the Multimedia-Energy Research Committee (MERC), this report summarizes the major research issues, highlights FY 1984 accomplishments that respond to these issues, and identifies research to be performed in FY 1985. The MERC is cochaired by Dr. Courtney Riordan (ORD) and Charles Elkins (OAR) and broadly represents the Agency's program and regional offices.

The overall goal of the multimedia energy research and development program is to provide the scientific and technical information necessary to support the Agency's permitting and standard-setting processes, and to allow for the development and utilization of energy sources in an environmentally acceptable manner. Research is conducted to better understand the phenomenon of acid deposition and provide information upon which mitigation decisions may be made; to expand EPA's knowledge of the performance, reliability, and cost of the limestone injection multistage burner (LIMB) control technology; to characterize and evaluate synthetic fuels discharges; to evaluate the impacts of energy development in cold climates.

Acid Deposition

Research on acid deposition is coordinated through the National Acid Precipitation Assessment Program (NAPAP), which is administered by the Interagency Task Force on Acid Precipitation. EPA is one of three joint-chairs of the Interagency Task Force, and has the lead role in the aquatic effects, control technology and assessment research areas. The term "acid rain" means the atmospheric deposition of acidic or acid-forming compounds in either dry or wet form. These compounds exist in the atmosphere as gases or aerosol particles containing sulfur oxides (SO_x), nitrogen oxides (NO_x), hydrogen chloride, sulfuric acid, nitric acid and certain sulfate and nitrate compounds. While scientists generally agree that these compounds are responsible for deposition of varying degrees of acidity, many questions still remain about the causes, effects, and methods of mitigating or controlling acid deposition. The objective of acid deposition research is to develop the necessary data to fully understand the sources and characteristics of acid deposition as well as the extent of damage or potential damage.

Major issues and associated outputs identified by the MERC for FY 1984-85 in the acid deposition research program are as follows:

A. Dry Deposition Monitoring

What is the best method to obtain dry deposition monitoring data comparable to that from the existing National Trends Network (NTN) which concentrates on wet deposition?

The acid rain research program is compiling a large volume of deposition data on wet precipitation. A growing body of evidence indicates that dry deposition, in the form of gases and aerosols, significantly contributes to total deposition. However, little data exists on dry deposition due to the difficulty in developing and deploying accurate monitoring instrumentation. Another problem is that the dry deposition rates vary with surface cover and topography as well as with environmental variables such as wind speed and humidity. As a result, the actual contribution of dry deposition, in most areas, can only be estimated. In an effort to obtain dry deposition monitoring data, ORD initiated field testing of the prototype dry deposition monitor in FY 1984. In FY 1985, the evaluation will be completed and the design of the dry deposition network finalized. A pilot network (6 stations) will be established in FY 1985.

B. Aquatic Effects of Acid Deposition

What future changes in surface water chemistry will occur assuming current levels of acid deposition remain constant, and what is the extent and rate-of-change to aquatic resources resulting from acid depostion?

The effects of acidification are most pronounced in sensitive aquatic systems. Acidic deposition is believed to be a major contributing factor in episodic depressions of pH which may result in reduced fish populations. The scientific uncertainties surrounding the aquatic effects of acidic deposition can be divided into several major categories: the extent of sensitive or acidic surface waters in the U.S.; the detection of long-term trends in surface water chemistry; predicting changes in surface water chemistry; the biological effects associated with surface-water acidification; and research on mitigation techniques. These uncertainties can be translated into questions of extent, rate, and magnitude of change attributable to acidic deposition.

National Surface Water Survey: In order to decrease the uncertainties related to the aquatic effects of acidic deposition, ORD initiated a National Surface Water Survey (NSWS). The NSWS is a field project in three distinct phases which documents the chemical and biological status of lakes and streams in regions potentially sensitive to acidic deposition. The Survey also will select regionally representative surface waters based on chemical, physical, and biological parameters to quantify future changes in aquatic resources through a long-term monitoring program.

The first phase of the NSWS is designed to quantify the chemistry of lakes and streams in areas now believed to contain the majority of low-alkalinity waters. This phase of the survey will determine what percentage of lakes and streams in the susceptible regions are acidic or have low

alkalinity. In FY 1984, the Eastern Lakes field survey was completed. In FY 1985, ORD will publish reports on the primary analysis of data from the eastern lakes survey and plans to complete the western lakes survey.

Phase II will quantify the biological components and the seasonal and spatial variability of a regionally representative subset of lakes and streams. These data should explain what percentage of lakes are devoid of fish, what chemical characteristics of surface waters are associated with the presence or absence of fish and what temporal variability can be expected in representative surface waters.

Phase III will define those lakes and streams as regionally representative sites for a long-term monitoring program to quantify future changes in the chemistry and biology of aquatic ecosystems.

Direct/Delayed Response: One of the most important questions in the aquatic effects research program is the extent of direct response and delayed response systems in the U.S. The variation in response times is expected to result from the differences in soil, bedrock, and hydrology. Therefore, some watersheds will be in dynamic equilibrium with acidic inputs from the atmosphere and will respond quickly, while others will exhibit significant sulfur retention or contain appreciable neutralizing capacities and will respond only after long delays. If direct response systems prevail in sensitive areas of the country, then no additional changes in surface water chemistry would be expected, given no change in present acidic loading rates. However, if delayed response systems predominate, then more waters may become acidic due to acidic deposition even if current loading rates do not change. Results from research will influence decisions concerning the immediacy of possible controls on sulfur emissions. In FY 1984, a research plan to investigate the direct/delayed response phenomenon was developed. In FY 1985, the initial soil survey field work will be conducted.

C. Terrestrial Effects of Acid Deposition:

What is the extent, rate, magnitude and cause of effects on watersheds, soils and forests as a result of acid deposition?

Terrestrial effects of acidic deposition falls into two major categories: effects on watersheds and soils; and effects on forests. The major issues have to do with whether effects can be shown or suspected, their extent, their magnitude and the rate at which they occur.

Watersheds and Soil Processes: Many processes within watersheds affect the rate and extent of the acidification of surface waters. Watershed bedrock geology, system hydrology and biological processes are all important determinants of the response of surface waters to acidic inputs from the atmosphere. Acidification of surface water is a watershed-level phenomenon and a full understanding of all the biogeochemical processes involved in watersheds is not expected for some years. EPA expects to expand its knowledge of the processes to the point of more accurately predicting the effects of changing acidic inputs. In FY 1985, ORD will accelerate the process-level research on the geochemical and physical characteristics of soils that are important in the response of surface waters.

Forests: Preliminary data on foliar damage and growth reductions in several species of trees in different forest ecotypes suggest that environmental pollution including acid deposition may be a major or contributing cause.

In FY 1985, EPA, in co-operation with the U.S. Forest Service, will initiate a survey of forests in the U.S. designed to measure the extent of currently unexplained foliar damage. While this survey cannot determine the causes, it should provide some estimates of the current and potential impacts of this problem.

EPA will accelerate research designed to identify the cause-and-effect mechanisms of forest changes and the interactive effects of air pollutants associated with acidic deposition. This research will be conducted in close cooperation with the U.S. Forest Service.

D. Assessment

What existing mechanism(s) would best integrate acid deposition research information to provide policy-makers with the ability to formulate timely and cost-effective decisions for dealing with the acid deposition issues?

The assessment research program performs two vital functions: (1) integrates the various aspects of the acid deposition research program, and (2) provides information to decision makers to formulate appropriate decisions that address acid deposition issues. A major part of this effort is to developments assessment tools and documents. In FY 1984, ORD published "The Acidic Deposition Phenomenon and Its Effects - Critical Assessment Review Papers."

Major acid deposition assessments are scheduled for 1985, and 1987 and 1989. The 1985 report will encompass an assessment of current damage, uncertainties to policy alternatives, and a framework for the integrated assessment methodology to be used in the 1987 and 1989 assessments.

Limestone Injection Multistage Burner (LIMB)

Another major research issue is "How does EPA promote innovative cost-effective energy-related pollution control technologies?" The most promising area is the development of the "limestone injection multistage burner" (LIMB) emission-reduction technology. The LIMB combines SO_x control with simultaneous NO_x control by using a mixture of pulverized coal and SO_x control by a factor of 3 to 4 and annual operating costs by 50 percent.

ORD continues to develop LIMB technology that is designed to reduce both SO_x and NO_x, the two major acid rain precursors. The LIMB technology is designed to be retrofitable to large and small existing coal-fired boilers. The LIMB performance goal is to reduce SO_x emissions by 50-70% and NO_x emissions by 50-80%. During FY 1984, ORD developed high surface area sorbents and sorbents treated with "promotors" such as sodium carbonate to improve the sulfur capture ability of the LIMB technology. Beyond possible acid rain retrofit, these developments may make the LIMB technology suitable

for use as a low cost control alternative for meeting New Source Performance Standards for boilers operating with low-sulfur coal. Laboratory tests are continuing to define the optimum conditions for the injection of the sorbent. During FY 1984, a cofunded tract for a full-scale demonstration of the LIMB technology on a wall-fired utility boiler was awarded to the Babcock and Wilcox Company. EPA is providing approximately 30% of the total funding for this demonstration. Most of the remainder of the funding will be provided by Babcock and Wilcox, the State of Ohio, and Ohio Edison. The demonstration is scheduled for completion by mid 1988. In FY 1985, ORD will prepare a report on bench scale evaluation of interactions of sorbent and mineral matter for wall-fired boilers.

Synthetic Fuels

An additional research issue is "How EPA develops methods to evaluate the health and environmental impacts of pollutants associated with synthetic fuel processes, including the characterization of discharges, and the assessment of emission-reduction technologies for mitigating these impacts?" These efforts assist industry and permitting officials by identifying problems which might impede the commercialization of the industry while ensuring the quality of the environment.

Energy Engineering: Research conducted by ORD significantly contributes to the advancement of an environmentally acceptable synthetic-fuels industry. Section 131(e) of the 1980 Energy Security Act (PL 96-294) specifies that any contract for financial assistance made with the U.S. Synthetic Fuels Corporation (SFC) include an approved plan for monitoring environmental and health-related discharges during the construction and operation of a synthetic fuels facility. EPA, as one of the consulting agencies to the SFC, is providing significant technical review and assistance to EPA regional and State officials on industry prepared Environmental Monitoring Outlines and Plans. In the absence of industry-specific regulations, regional and State officials are relying heavily on ORD's research results and professional expertise to determine the applicability of existing permits to control pollutants from proposed synthetic fuel facilities. Considerable technical assistance and document review is provided to State and local authorities receiving Environmental Impact Statements (EISs) and permit applications for proposed controls on synthetic fuel facilities. In addition, ORD technical reports were published that evaluated the effectiveness of control technologies in the synthetic fuels industry. In FY 1984, ORD published an assessment document entitled "Source Test and Evaluation Report - Rectisol Acid Gas Removal."

Energy Health: The primary purpose of this research was to provide procedures for conducting health and environmental risk assessments in the vicinity of proposed or actual synfuel production facilities. These procedures are useful to EPA, other Federal agencies, State agencies, and the private sector in assessing health and environmental risks that result from the installation and operation of a synfuels facility at any given location.

In FY 1985, ORD will publish a Users Manual for estimating health risks of chemicals from synfuels production to the general population in the

vicinity of a proposed or actual facility and a Users Manual for estimating environmental risks of chemicals from synfuels production beyond the boundaries of a proposed or actual facility.

Cold Climate

The last research issue involves "How can EPA better define the impacts of coal, oil and gas development and atmospheric pollution on Alaska's unique artic and sub-artic ecosystem?"

The Cold Climate Research Program addresses environmental and health problems applicable to most cold weather regions, but primarily problems in the State of Alaska where natural resource development, expanding population and the extreme climate pose unique environmental and health problems. The research program concentrates on those areas of highest concern to Region X and the State. In FY 1984 a three-year program which had focused on the carbon monoxide (CO) problem in urban Alaska was completed. A final report on automobile emissions of CO in non-attainment areas of Alaska was published.

In FY 1985, the Cold Climate Program will shift its emphasis to resource development and habitat modification issues, including the impacts of oil and gas development, the environmental impacts of placer mining, the evaluation of asbestos in drinking water, the toxicology and fate of petroleum hydrocarbons in oiled waters, and the impact of particulates, particularly woodsmoke, on human health in urban areas.

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